CLAIMS

1. A micro-lens array substrate comprising first and second micro-lens arrays respectively having a plurality of lenses,

wherein:

said first micro-lens array is sandwiched between two inorganic dielectric substrates; and

said second micro-lens array is formed on either one of said two inorganic dielectric substrates.

2. The micro-lens array substrate as set forth in claim 1 wherein the first micro-lens array and the second micro-lens array are made from a layer of resin whose refractive index is different from a refractive index of the inorganic dielectric substrates.

3. The micro-lens array substrate as set forth in claim 1 or 2, wherein the second micro-lens array is a stack of two or more layers of resin whose respective refractive indexes are different from one another.

4. The micro-lens array substrate as set forth in any one of claims 1 through 3, wherein the second micro-lens array is made of ultraviolet curable resin.

5 . A production method of a micro-lens array substrate, comprising the steps of:

forming on an inorganic dielectric substrate a first micro-lens array with a plurality of lenses;

applying a photosensitive resin on the first micro-lens array;

patterning the photosensitive resin by irradiation of ultraviolet light or visible light; and

forming a second micro-lens array using the patterned photosensitive resin as a mask,

said step of patterning the photosensitive resin being carried out using a beam that has transmitted through the first micro-lens array.

6. The production method of a micro-lens array substrate as set forth in claim 5,

wherein:

a middle layer made of an inorganic dielectric material is formed on the first micro-lens array substrate, and

the photosensitive resin, which is formed on the middle layer, is patterned by irradiation of visible light or ultraviolet light through the first micro-lens array and the middle layer, so as to form the second micro-lens array.

7 . The production method of a micro-lens array substrate as set forth in claim 6, wherein the first micro-lens array is set to have a focal plane in the vicinity of the photosensitive resin formed on the middle layer.

8. The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7,

wherein:

a negative resist layer is used as the photosensitive resin;

the negative resist layer is patterned by irradiation of the beam that has transmitted through the first micro-lens array; and

etching is carried out on the negative resist layer so as to transfer a patterned shape of the negative resist layer to the inorganic dielectric substrate.

9. The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7,

wherein:

the photosensitive resin formed on the inorganic dielectric substrate has a two-layer structure of a first photosensitive resin and a second photosensitive resin, and

said production method further comprises the steps

of:

applying and curing a visible light curable resin or an ultraviolet curable resin as said first photosensitive resin on the inorganic dielectric substrate; and

applying a negative resist as the second photosensitive resin, and

wherein:

the second photosensitive resin is patterned into the second micro-lens array; and

the second micro-lens array is etched to transfer the pattern of the second micro-lens array to the first micro-lens array.

10. The production method of a micro-lens array substrate as set forth in any one of claims 5 through 7,

wherein:

an ultraviolet curable resin is used as the photosensitive resin formed on the inorganic dielectric substrate, and

the second micro-lens array is formed by:

curing the ultraviolet curable resin by irradiation of the beam that has transmitted through the first micro-lens array, and

removing uncured portions of the ultraviolet curable resin with an organic solvent.

11. The production method of a micro-lens array substrate as set forth in any one of claims 5 through 10,

wherein:

the first micro-lens array is irradiated with a parallel ray with a uniform intensity distribution; and

patterning of the second micro-lens array is carried out with the micro-lens array substrate tilted with respect to an optical axis of the parallel ray.

12. The production method of a micro-lens array substrate as set forth in any one of claims 5 through 10,

wherein patterning of the second micro-lens array is carried out using an irradiated light image formed by irradiating the first micro-lens array with irradiated light whose intensity distribution has been determined by a transmittance modulation mask whose transmittance is continuously modulated.

13. A projection liquid crystal display device comprising:

a white beam source;

beam splitting means for splitting a white beam from said white beam source into a plurality of beams of different wavelength bands;

a liquid crystal element, which is irradiated with the beams split by said beam splitting means; and

projection means for projecting a plurality of beams modulated through said liquid crystal display element,

said liquid crystal display element having a first micro-lens array and a second micro-lens array on a side closer to said white beam source, and

said second micro-lens array having a lens shape patterned by beams that have transmitted through said first micro-lens array.

14. A projection liquid crystal display device comprising:

a white beam source; and

a liquid crystal display element, which is irradiated with a plurality of beams of different wavelength bands produced by splitting white-light from said white beam source,

said liquid crystal display element having a first micro-lens array and a second micro-lens array on a side closer to said white beam source, and

said second micro-lens array having a lens shape patterned by beams that have transmitted through said first micro-lens array.

15. (New) A micro-lens array substrate comprising a first micro-lens array having a plurality of lenses,

wherein:

said first micro-lens array is sandwiched between two inorganic dielectric substrates; and

a three-dimensional structure is formed on one of said two inorganic dielectric substrates.

16. (New) The micro-lens array substrate as set forth in claim 15, wherein the lenses of said first micro-lens array, and said three-dimensional structure are disposed at the same pitch.

17. (New) The micro-lens array substrate as set forth in claim 15 or 16, wherein said three-dimensional structure is a second micro-lens array.

18. (New) The micro-lens array substrate as set forth in claim 17, wherein said second micro-lens array comprises: the inorganic dielectric substrates; and a layer of resin whose refractive index is different from that of the inorganic dielectric substrates.

19. (New) A production method of a micro-lens array substrate comprising the steps of:

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forming a first micro-lens array having a plurality of lenses;

applying a photosensitive resin on the first micro-lens array;

patterning the photosensitive resin by irradiation of ultraviolet light or visible light;

forming a three-dimensional structure using the patterned photosensitive resin as a mask;

said step of patterning the photosensitive resin being carried out using a beam that has transmitted through the first micro-lens array.

20. (New) The production method of a micro-lens array substrate as set forth in claim 19, further comprising steps of:

forming on an inorganic dielectric substrate the first micro-lens array having the plurality of lenses;

pasting a middle substrate on the inorganic dielectric substrate with a predetermined resin in between;

polishing a surface of the middle substrate, opposite the inorganic dielectric substrate, so as to adjust a thickness of the middle substrate to a predetermined thickness; and

applying the photosensitive resin on the polished surface of the middle substrate, so as to form the three-dimensional structure.

21. (New) The production method of a micro-lens array substrate as set forth in claim 19 or 20, wherein the three-dimensional structure is a second micro-lens array.

22. (New) The production method of a micro-lens array substrate as set forth in claim 20 or 21, wherein a focal plane of the first micro-lens array is set in a vicinity of the photosensitive resin formed on the middle substrate.

23. (New) The production method of a micro-lens array substrate as set forth in claim 21 or 22,

wherein:

the photosensitive resin formed on the middle substrate has a two-layer structure of a first photosensitive resin and a second photosensitive resin; and

said production method further comprises the steps of:

applying and curing a visible light curable resin or a ultraviolet curable resin as the first photosensitive resin

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on the middle substrate; and

applying a negative resist as the second photosensitive resin, and wherein:

the second photosensitive resin is patterned into the second micro-lens array; and

the second micro-lens array is etched to transfer the pattern of the second micro-lens array to the first micro-lens array.

24. (New) The production method of a micro-lens array substrate as set forth in claim 21 or 22,

wherein:

an ultraviolet curable resin is used as the photosensitive resin on said middle substrate; and

the second micro-lens array is formed by:

curing the ultraviolet curable resin by irradiation of the beam that has transmitted through the first micro-lens array; and

removing uncured portions of the ultraviolet curable resin with an organic solvent.

25. (New) A production method of a three-dimensional structure comprising the steps of:

applying a photosensitive resin on an optical member;

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patterning the photosensitive resin by irradiation of visible light or ultraviolet light;

forming a three-dimensional structure using the patterned photosensitive resin as a mask,

said step of patterning the photosensitive resin uses a light beam that has transmitted through an optical element having condensing function.

26. (New) The production method of a three-dimensional structure as set forth in claim 25, wherein said optical element having condensing function is formed or fixed on said optical member.

27. (New) The production method of a three-dimensional structure as set forth in claim 25 or 26, wherein a plurality of said optical elements having condensing function are provided.

28. (New) The production method of a three-dimensional structure as set forth in any one of claims 25 through 27, wherein:

said optical element having condensing function is irradiated with a parallel ray having a uniform intensity distribution; and

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patterning of the three-dimensional structure is carried out by tilting the optical member with respect to an optical axis of the parallel ray.

29. (New) The production method of a three-dimensional structure as set forth in claim 28, wherein the three-dimensional structure is patterned by:

adjusting a tilt angle of the optical member; and

adjusting intensity or irradiation time of the irradiated parallel light.

30. (New) The production method of a three-dimensional structure as set forth in any one of claims 25 through 27, wherein:

patterning of the three-dimensional structure is carried out using an irradiated light image formed by irradiation of the optical element having condensing function with irradiated light whose intensity distribution has been determined by a transmittance modulation mask whose transmittance is continuously modulated.